STEP-NC ProbingDemonstration
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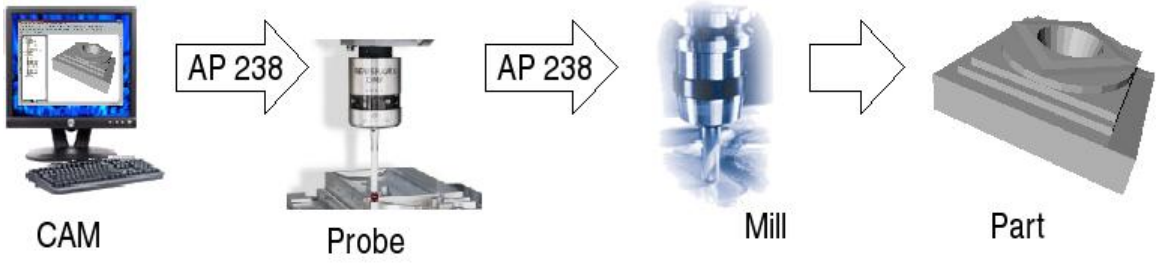

Purpose of This Document

This document describes the scenario for a demonstration of probing capabilities supported by STEP-NC AP-238 at the Society of Manufacturing Engineers EASTEC show, 24-26 May 2005 in West Springfield, Massachusetts. The demonstration will highlight the use of probing results collected on an NC machine to generate modified AP-238 data. The audience for this document is primarily the group of participants, although it does suggest how STEP-NC will be used in practice and is informative to anyone interested in the technology. Participants should read the scenario to understand what will be expected of them during the demonstration, so there are no surprises.

Probing Concepts

The ISO 14649 STEP-NC data model specifies 3 types of probing: `workpiece_probing`, `workpiece_complete_probing`, and `tool_probing`. `tool_probing` is used to determine the actual diameter and length of a cutting tool to account for tool where, and will not be demonstrated here.

`workpiece_probing` is single-direction probing from a starting location known to be free of the workpiece along a direction to a nominal expected distance. The difference between the actual probe trip distance and the nominal expected distance is recorded in a STEP-NC variable. This result can be used to determine corrective action, such as remachining, or to compute setup offsets.

`workpiece_complete_probing` is a full-featured probing operation that determines a full coordinate transformation from a part's nominal fixturing position

and orientation to its actual position and orientation. 6 probe measurements are taken at locations determined by the CNC automatically based on the workpiece geometry. Since no starting location is given, presumably the part must be close to its nominal position, unless another method (such as a camera) can acquire the rough initial position and orientation of the workpiece.

For this demonstration, `workpiece_probing` will be used to probe locations on the workpiece, in order to compute position- and orientation offsets. For 3-axis machining we can expect to be able to handle x-y-z offsets and a single θ orientation change, e.g., the offsets that would result if the workpiece were clamped atop a thin shim of unknown thickness, close to some locating feature and slightly misaligned. This puts the probing operation somewhere between `workpiece_probing` and `workpiece_complete_probing`.

Each probed result is stored into the STEP-NC variable `measured_offset`, which will be read out and saved by a program that computes the final transformation. Once the transformation has been acquired, the STEP-NC converter will adjust the NC code accordingly when it writes out the just-in-time NC code.

Note that a single NC program for both the probing and subsequent machining cannot be generated ahead of time by the STEP-NC converter. Although single NC programs are often written that include probing for offsets, these offsets apply to a single axis, e.g., one probes in the x direction for an offset, then writes the x axis offset register with this value. In our demonstration, offsets are coupled due to the possible θ misalignment, and resident single-axis offsets cannot be used to accomplish the full transformation. So, one AP-238 program will be used for the probing, a second AP-238 program will specify the machining in nominal coordinates, and the STEP-NC converter will generate NC code using the nominal AP-238 program and the acquired transformation just prior to machining.

Scenario

The scenario is as follows:

1. Prior to the demo, AP-203 geometry for the part and stock will be imported by UGS' NX and a CAM phase will be run to generate AP-238 CC1 data for both the probing and machining programs.

2. The original AP-203 geometry for the workpiece and stock will be added to the AP-238 output, making it a CC2 file.

3. Some number of copies of the part will be machined in a single setup, say 4. The parts will be fixtured roughly in their nominal locations, but will vary visibly in their orientation.

4. A touch-trigger probe will determine the actual x-y-z location and θ orientation of each of the 4 parts.

5. The AP-238 converter resident on the CNC will generate NC toolpaths based on the nominal AP-238 data and the collected x-y-z-θ transformation. Machining proceeds, and noticeable x-y motion will be seen during previously single-axis cuts due to the transformation.